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GEARING UP for SAFETY

SUMMARY

Motor Carrier Safety in a Competitive Environment

CONGRESS OF THE UNITED STATES OFFICE OF TECHNOLOGY ASSESSMENT

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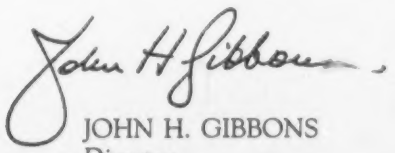
Foreword

Trucks carry three-quarters of the dollar value of all commercial goods transported in the United States, and the speed, convenience, and cost-effectiveness of truck transport make this ratio unlikely to change quickly. The intercity bus and commercial trucking industries are governed by Federal motor carrier regulations, and the Motor Carrier Act of 1980 eliminated many economic restrictions limiting entry to the industry. Federal safety regulations remain basically unchanged, however, and were expanded gradually in range and coverage during the 1980s. Despite this, the number of highway accidents involving heavy trucks climbed during the first half of the decade, prompting concern among public and industry officials, alike. As I write this, the southwest horizon beyond my window—Virginia—is punctuated by a billowing, black cloud from a classic tanker truck accident and fire.

Although many studies on the impacts of deregulation have been undertaken, questions have lingered about the adequacy of existing Federal safety policies and programs. The Committee on Public Works and Transportation and the Subcommittee on Government Activities and Transportation of the Committee on Government Operations, both of the House of Representatives, asked the Office of Technology Assessment to determine how well existing safety policies, regulations, and technologies meet the government's responsibility for ensuring safety in the motor carrier industry. The study was endorsed by the Senate Committee on Commerce, Science, and Transportation.

This report contains the results of that analysis. A review of critical intergovernmental issues for the Department of Transportation and State Governments has been added to the basic questions about the adequacy of Federal standards and programs. During the course of the study, it became clear that the report would have to consider how policy is implemented, and consequently, the relationship between the Department of Transportation and the States, which have become important partners in Federal safety programs. This comprehensive look at motor carrier safety also includes the economic framework of the industry as it affects operations, an analysis of safety data, and a review of research and development needs for safety technologies for both industry and government.

Throughout the study, the advisory panel, review group, workshop participants, and a host of contributors played key roles in developing the major issues and contributed a broad and invaluable range of perspectives. OTA thanks them for their substantial commitment of time and energy. Their participation does not necessarily represent endorsement of the contents of the report, for which OTA bears sole responsibility.



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NOTE: OTA appreciates and is grateful for the valuable assistance and thoughtful critiques provided by the advisory panel members. The panel does not, however, necessarily approve, disapprove, or endorse this report. OTA assumes full responsibility for the report and the accuracy of its contents.

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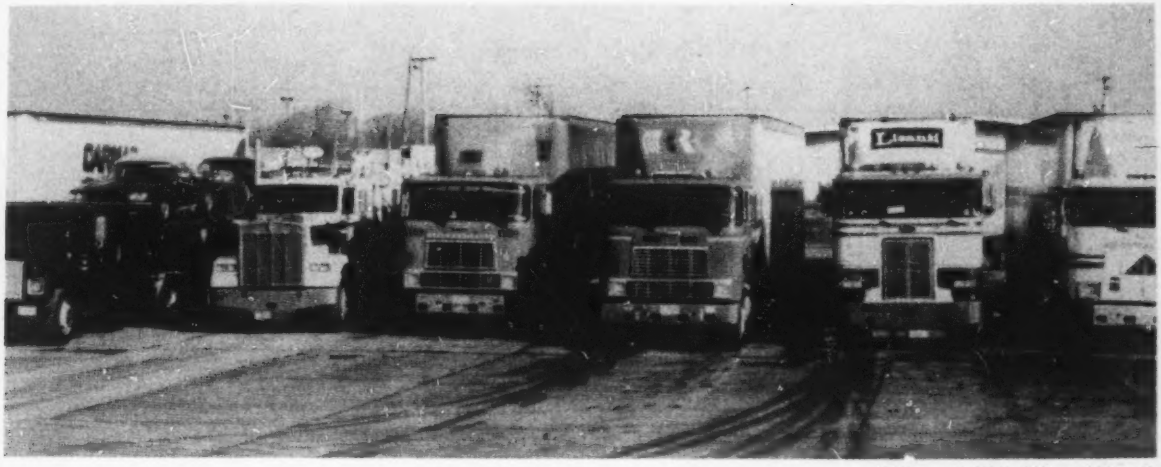


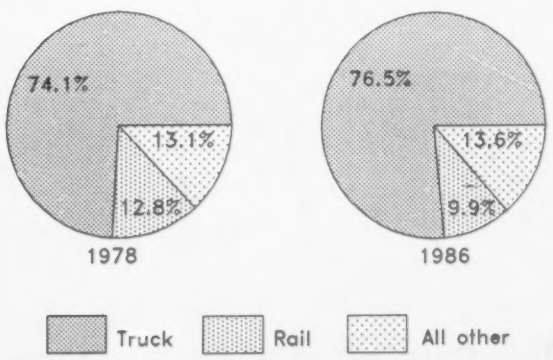
Photo credit: Michael Hines, OTA staff

Summary

Goods ranging from lettuce to automobile parts and steel cables are carried by trucks of all sizes and types from manufacturers to factories, stores, and homes. Freed by the Motor Carrier Act of 1980 from many Federal rules governing entry, pricing, and services, the trucking industry has capitalized on its speed, flexibility, and cost-effectiveness to enhance its dominant role in commercial goods transport—and no serious challenger is on the horizon. Today, trucking accounts for more than three out of every four dollars spent on domestic freight transportation (see figure 1-1). Trucking companies have continued to enlarge their market share by keeping rate increases small over the past 8 years—well below rises in the consumer price index. Rates charged to large volume shippers have actually declined in real terms.[1] Carrier costs, however, have increased more than rates have risen. Companies that have survived the resulting economic squeeze have done so by streamlining operations and cutting costs to improve productivity. Many were unable to modernize sufficiently to compete and succumbed to falling profits and cash flow problems.

[1]Alex Brown & Sons, Inc., "Wrap-Up of the October 29 Trucking Seminar," unpublished manuscript, December 1987.

Figure 1-1.—Total Freight Revenues by Modal Shares, 1978 and 1986



NOTE: "All other" includes air, pipeline, water, freight forwarders, and miscellaneous shipper costs.

SOURCE: Office of Technology Assessment, 1988; based on data from Transportation Policy Associates, "Transportation in America," November 1986, as cited in American Trucking Associations, Inc., "American Trucking Trends," 1987.

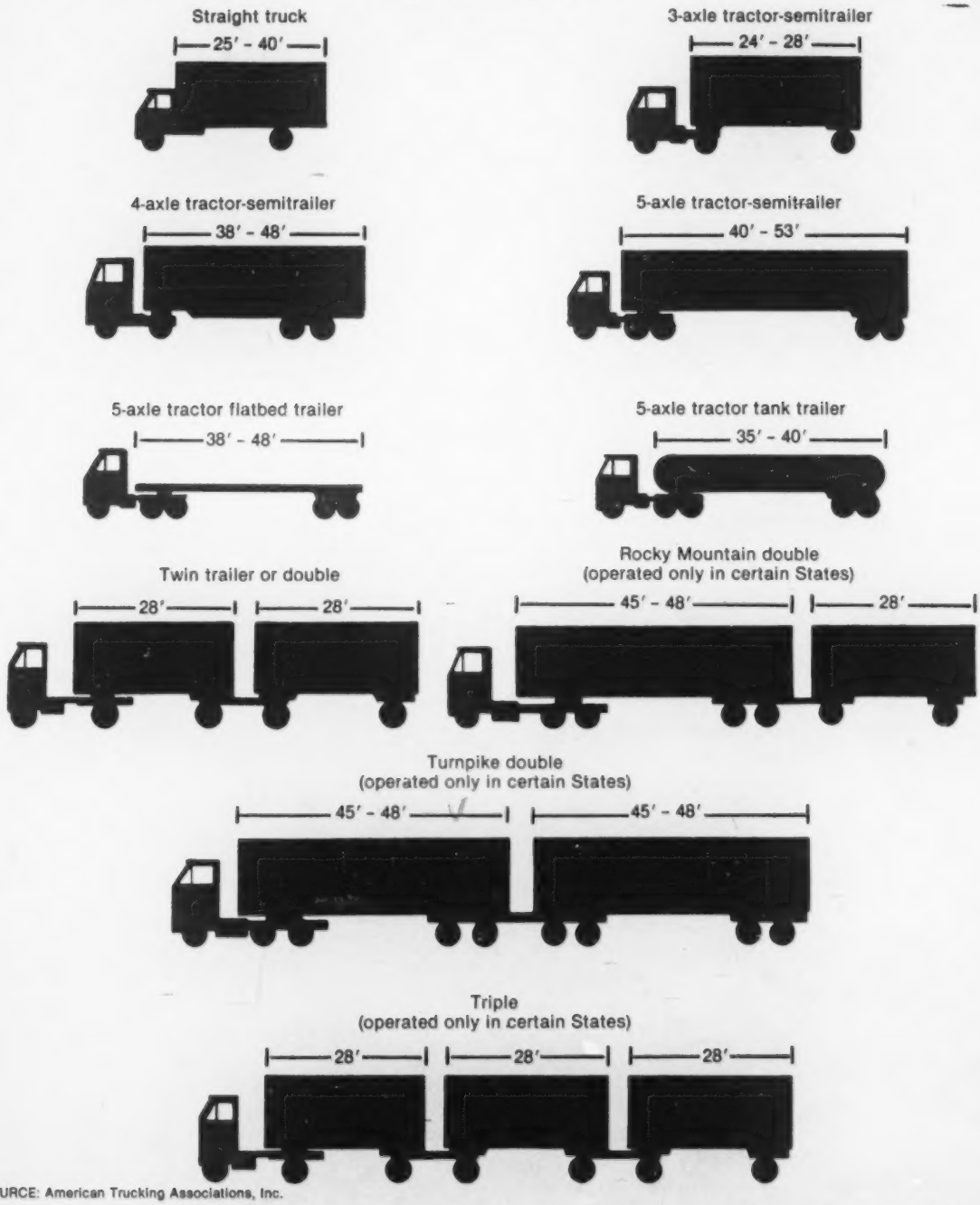
Intercity buses are also part of the motor carrier industry—a part that has not fared well in recent years. Former bus travelers purchased automobiles or were lured by lower air fares available after airline deregulation, shifting to other transport modes in large numbers; the number of revenue bus passengers declined by about 5 percent in the 1980s. Bus companies consolidated service, abandoning routes in lightly populated rural areas, and leaving some former passengers without readily available transportation service.

Despite the vital services they provide, large vehicles, both buses and heavy trucks,[2] are perceived as menaces on the roads by many members of the driving public—much to the concern of the industry. Steady increases in highway traffic have exacerbated long-standing heavy vehicle safety problems; indeed, the number of vehicles now exceeds highway design capacity in many urban areas. Today's trucks and buses are larger and heavier than those of 6 to 8 years ago and travel more miles over the Nation's highways—most of which were designed for automobiles. Highways, such as the Interstate system, which were constructed with truck use in mind, were built for a vehicle comprised of a tractor pulling a 96-inch wide, 40- to 45-foot long trailer—considerably smaller than the combination vehicles now standard. (Figure 1-2 gives examples of some of the vehicles now common on major arteries.) This makes handling today's large trucks safely through turns, on curves and ramps, passing vehicles, and stopping within the appropriate distances a challenge, even for skilled, well-trained, and experienced drivers.

Government officials and safety experts have long sought ways to achieve a responsible balance between ensuring highway safety and facilitating the flow of commerce. For example, after economic deregulation in 1980, a major Federal safety program

[2]Heavy trucks are those with gross vehicle weights of 26,001 pounds and over—the focus for much of this study because the category includes combination tractor-trailers, vehicles that pose the greatest driving challenges and the largest safety hazards.

Figure 1-2.—Truck Types



SOURCE: American Trucking Associations, Inc.

Lengths shown are typical; shorter or longer lengths are possible depending on carriers' needs and State laws.

was enacted—the Motor Carrier Safety Assistance Program (MCSAP), authorized as part of the Surface Transportation Assistance Act (STAA) of 1982. This program has assisted 48 States in building their safety and enforcement capabilities. Nonetheless, the number of accidents involving heavy trucks increased a total of 15 percent over the 5 years between 1981 and 1986, the last year for which accurate Federal data are available.[3] This increase is slightly greater than the increase in truck-miles traveled.

The number of fatalities in heavy truck accidents has held constant between 4,000 and 5,000 annually over the last 10 years despite the rise in travel, a credit to safety efforts. However, four out of every five people killed in accidents involving truck tractor-trailer combinations are occupants of the other vehicle, usually a car.[4] Between 1 and 2 percent of accidents involving these trucks result in a fatality; the comparable figure for all other types of motor vehicles (except motorcycles) is well under 1 percent. In short, despite the steps taken to improve heavy vehicle safety, concerns persist.

Accidents usually happen as a result of a sequence of events, often initiated by a single occurrence complicated by a number of interacting factors. **Federal data from the National Accident Sampling System (NASS) indicates that the three most common factors associated with heavy vehicle accidents are: 1) speed too fast for conditions; 2) level of training of the driver; and 3) age of the vehicle.** These factors are related to a range of activities that are affected by government and every segment of the motor carrier industry.

[3]OTA calculations, based on National Accident Sampling System data and information provided by National Highway Traffic Safety Administration staff.

[4]OTA calculations, based on data from the Fatal Accident Reporting System.

To identify changes to existing Federal policies and programs that address these and related safety issues, the Office of Technology Assessment (OTA) took a comprehensive look at the motor carrier industry and the spectrum of safety programs. Research included a review of the numerous Department of Transportation (DOT) and State regulatory, enforcement, and safety programs; accident data resources, truck studies, and accident analyses; and raw accident data. Industry operations and financial performance were assessed, using data from published sources and information provided by both large and small carriers. As a result of this wide-ranging effort, **OTA concluded that addressing motor carrier safety issues successfully requires a comprehensive and stategic approach. Congress' choices are to formulate and enact such an approach into law, to institute more aggressive congressional oversight practices, or to leave the problem in the hands of the executive branch. Action is needed in three key areas:**

- **increased attention to human performance factors, including training guidelines for drivers and maintenance personnel, driver hours of service and fatigue, and management practices, such as hiring, scheduling, and drug and alcohol testing;**
- **stepped-up requirements for technologies to improve safety in over-the-road vehicle operations. These must address vehicle design and equipment requirements, such as tractor-trailer brake compatibility, antilock brakes, and vehicle visibility enhancements, as well as highway structure and design; and**
- **concentrated efforts to integrate government activities across all jurisdictional levels, to increase national uniformity for regulations and enforcement, and to improve regulatory compliance for all motor carriers.**

Box 1-A provides a summary of major policy options and cost estimates.

BACKGROUND

The Motor Carrier Act of 1980 changed or eliminated Federal economic requirements for many segments of the trucking industry, but retained existing safety regulations. Congress has enacted several additional safety measures for motor carriers over the intervening years to enhance Federal safety oversight for interstate commerce, focusing on enforcement, and to a lesser degree, the driver and the ve-

Box 1-A.—Motor Carrier Safety—Policy Options and DOT Opportunities

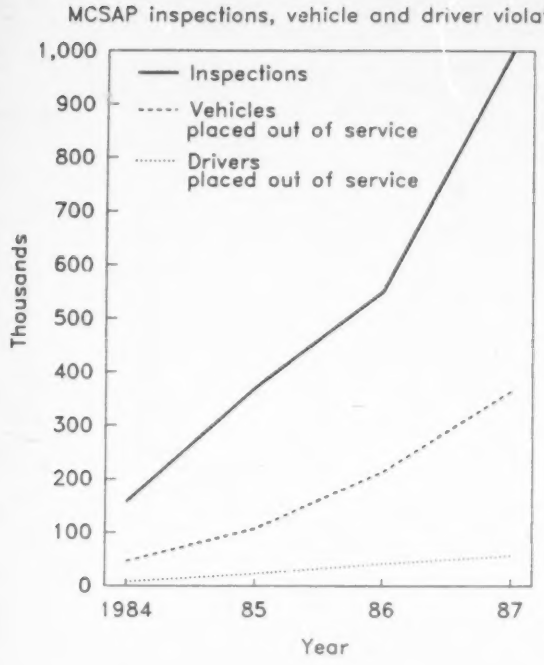
Options and opportunities	Lead agency: coordinate with	Costs ($ millions) Fixed	Recurring
Policy options			
1. Increase MCSAP funding to improve regulatory uniformity and compliance; provide technical assistance for State programs	**OMC:** NHTSA, FHWA, States		200
2. Undertake research on fatigue and sleep problems; revise hours-of-service rules; develop technical guidance for hiring and scheduling	**OMC/NHTSA:** medical community, industry, labor, MCSAP, NTSB	2.0	<1
3. Undertake research to reduce the effects of heavy truck accidents; develop and issue standards and implement programs for improved vehicle visibility, underride guards, and splash and spray reduction, etc.	**NHTSA:** OMC, States, industry	2.5	<1
4. Centralize DOT accident and exposure data collection and analysis; provide technical assistance for State programs	**NHTSA/FHWA:** States	2.3	<1
5. Undertake research on drug impairment levels; develop standards	**OMC:** medical community, NTSB, industry, labor	2.0	<1
DOT opportunities[1]			
1. Develop national guidelines for driver training programs	**OMC:** universities, CVSA, industry	0	0
2. Improve tractor-trailer brake compatibility; complete antilock brake tests and rulemaking	**NHTSA/OMC:** industry	0	<1
3. Revise standards for road signs for heavy vehicles	**FHWA:** NHTSA, States	0	<1
4. Prohibit radar detector use	**FHWA:** NGA, MCSAP officials	0	0

[1]DOT staff costs included additional program costs minimal and shared among groups.
KEY: DOT = U.S. Department of Transportation.
< = less than.
OMC = Office of Motor Carriers.
NHTSA = National Highway Traffic Safety Administration.
FHWA = Federal Highway Administration.
CVSA = Commercial Vehicle Safety Alliance.
MCSAP = Motor Carrier Safety Assistance Program.
NGA = National Governors' Association.
NTSB = National Transportation Safety Board.
SOURCE: Office of Technology Assessment, 1988.

hicles. Major legislation has included MCSAP (1980), requirements for annual truck inspections and for DOT to rate the safety fitness of all carriers (1984), and a national requirement for a single commercial vehicle driver's license (1986).

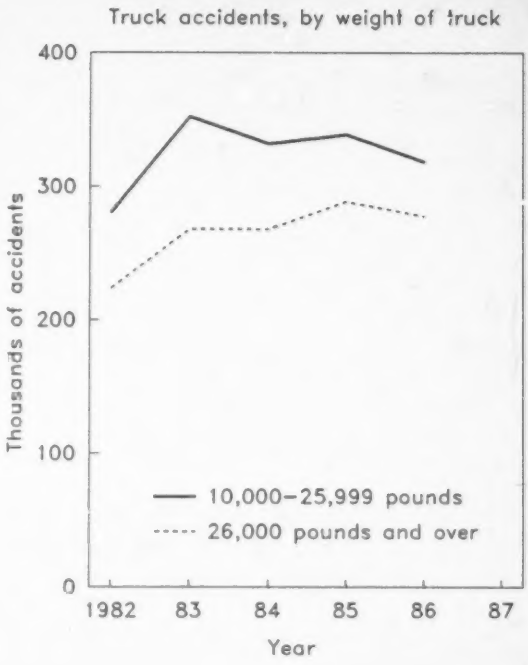
Such legislation takes time to implement on a national scale and even longer to show results on the highways. Yet, over the past 3 to 4 years, MCSAP has improved State inspection and enforcement capabilities dramatically. This cooperative Federal/State effort may well have played a role in the slight drop in the number of heavy vehicle accidents that occurred in 1986 (see figure 1-3). It has also caused record numbers of trucks and buses to be pulled out of service for violations. In States where enforcement officers target likely violators, as many as 60 percent of commercial vehicles have been pulled out

Figure 1-3.—MCSAP Inspection Rates Compared With Truck Accident Rates



KEY: MCSAP = Motor Carrier Safety Assistance Program.

SOURCE: U.S. Congress, Senate Committee on Commerce, Science, and Transportation, *Motor Carrier Safety Assistance Program: Options Intended to Improve a Generally Successful and Cooperative Federal/State Partnership Promoting Truck and Bus Safety* (Washington, DC: U.S. Government Printing Office, 1988), table 2, p. 18.



SOURCE: Office of Technology Assessment, 1988; based on National Accident Sampling System data, 1981-86. Data for 1987 are not yet available.

of service for violations. **Even in States where efforts are made to perform completely random inspections, 30 percent of inspected vehicles are being put out of service.**[5]

The STAA also authorized operation of trucks with trailers 102-inches wide and 48-feet long, or two 28-foot double trailers, on all Interstate highways and certain roads designated as part of the National Truck Network. The act allowed these vehicles to operate as necessary on other roads to gain "reasonable access" to terminals for pick up and delivery, although States retained responsibility for

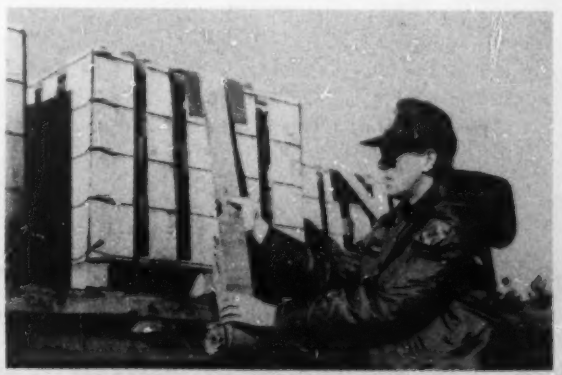


Photo credit: Commercial Vehicle Safety Alliance

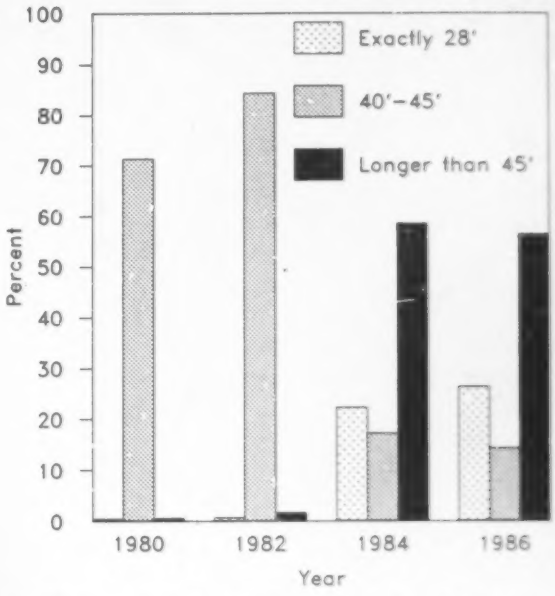
State inspectors identify safety hazards before an accident occurs.

[5]Paul Melander, Tennessee Public Service Commission, personal communication, Mar. 23, 1988.

defining "reasonable access." Carriers moved quickly to take advantage of the opportunity to use larger trailers (see figure 1-4), and longer, wider vehicles now dominate intercity motor transport. In fact, encouraged by potent industry lobbying, many States permit 53-foot trailers or even longer combination vehicles, all of which exceed the limits of existing highway designs. Operating a heavy vehicle safely under such circumstances requires an experienced, well-trained driver, capable of quick and alert performance and accurate judgment and decisionmaking, as well as a well-maintained vehicle.

Several studies have indicated that automobile drivers cause up to 50 percent of multiple vehicle truck accidents. Regardless of who is at fault, accident costs are spread widely, and often are paid as much by the injured, the rescuers, and inconvenienced travelers as by the party that caused the accident. Thus, a comprehensive program to improve carrier safety must address issues related to drivers of both heavy vehicles and automobiles, to the heavy vehicles themselves, and to road design and management. **While a national program to improve motor carrier safety may well bring somewhat higher direct transportation costs, these could be balanced by a reduction in the societal costs of highway accidents, which, it was recently estimated, will reach $65 billion by 1990.**[6]

Figure 1-4.—Trailer Sales Since 1980, by Length



SOURCE: Truck Trailer Manufacturers Association, "Van Trailer Report," various years.

Photo credit: Ohio State Highway Patrol

Heavy truck accidents delay traffic and have significant societal costs.

[6]U.S. Congress, House Committee on Public Works and Transportation, *The Status of the Nation's Highways: Conditions and Performance*, Report of the Secretary of Transportation (Washington, DC: U.S. Government Printing Office, 1987).

FRAGMENTED GOVERNMENTAL FRAMEWORK

Attempts to address safety issues in a comprehensive and systematic manner are stymied by the vast varieties and numbers of governmental bodies that share responsibilities for truck safety and the far flung, disparate nature of the trucking industry. At the Federal level, the Interstate Commerce Commission (ICC), and three DOT agencies oversee different aspects of trucking through setting standards and enforcement. Within DOT, the National Highway Traffic Safety Administration (NHTSA)

sets and enforces standards and requirements for the manufacture of new vehicles. The Office of Motor Carriers (OMC) in the Federal Highway Administration (FHWA) has regulatory and enforcement responsibility for the drivers, carrier operations, and the companies operating the vehicles. The Research and Special Programs Administration regulates containers used in highway transportation of hazardous materials (see table 1-1). A number of other offices within FHWA set standards for highway design and approve funding programs for State highway construction. These units rarely work closely on carrier safety issues; in fact NHTSA and OMC each have separate advisory groups for truck matters. In Congress, a similar number of committees have jurisdiction over different aspects of motor carrier safety.

At the State level, numerous groups play roles, with Governors' offices, State legislatures, and Departments of Transportation, Highways, Police, and Public Safety, as well as regulatory bodies, such as Public Utilities Commissions or Public Service Commissions as major actors. Within States, responsibilities are divided differently, and agencies have separate and often incompatible approaches to activities such as issuing inspection stickers, penalties for overweight trucks, and highway access decisions.

Table 1-1.—Overview of Federal Regulatory Responsibilities for Motor Carrier Safety

Department of Transportation Administration	Senior Official	Responsibilities
Federal Highway Administration (FHWA)	Associate Administrator for Engineering and Program Development	Determines how truck access affects the highway system
	Associate Administrator for Research, Development and Technology	Manages research on the adequacy of highway design to accommodate trucks
	Associate Administrator for Motor Carriers	Establishes and enforces operating regulations for commercial motor carriers; includes driver and maintenance requirements
	Associate Administrator for Policy	Studies the implications of longer combination vehicle used on the Nation's highway system
National Highway Traffic Safety Administration (NHTSA)		Establishes regulations for the manufacture of new vehicles and related equipment; investigates safety-related equipment defects
Research and Special Programs Administration (RSPA)		Establishes and enforces regulations for containers used in used in transportation of hazardous materials

SOURCE: Office of Technology Assessment, 1988.

THE DIVERSE INDUSTRY

The governmental framework seems simple when compared to the motor carrier industry, or more accurately, the industries. The intercity bus industry is but one small segment. Heavy truck operators include companies owning from 1 to 500 or more trucks, doing business as private or for-hire carriers, carriers of exempt commodities, owner-operators, intermodal-operators, and interstate and

intrastate carriers (see figure 1-5). Freedom to enter the market and compete for available customers has had far-reaching effects on virtually all of these—diminishing the differences between common and contract carriers and expanding the opportunities for private carriers. The number of ICC-regulated carriers (about 33 percent of the Nation's total number of carriers) more than doubled between 1978 and 1986, with most of the growth in the smallest ICC revenue category, Class III (carriers with revenue under $1 million annually). The number of large (Class I and II) carriers declined slightly over this time period, however, as carriers declared bankruptcy or changed hands (see figure 1-6).

Although many of the new entries were not new to trucking, having previously operated as exempt or private carriers, the services they offered created considerable excess capacity at the same time as the 1981-82 recession and its aftermath damped factory production and shipment levels. As a result, rates tumbled and carrier profit margins fell, even for the historically most profitable carriers (see figure 1-7). While accurate data are hard to acquire since companies leaving the industry need not report to ICC, estimates are that the number of carriers merging or going out of business climbed steadily from under 200 a year in 1978 and 1979 to over 1,500 in 1986.

Surviving carriers have in common a lean, cost-conscious management approach focused on ways to increase market share, often through specialized service. Carriers of all sizes have been affected by rate competition and forced to examine alternatives to utilize capacity and to increase productivity. Companies that have succeeded in meeting specialized market demands or that have a financial cushion adequate to support investments in equipment, facilities, and well-qualified drivers (important for safety) can do well.

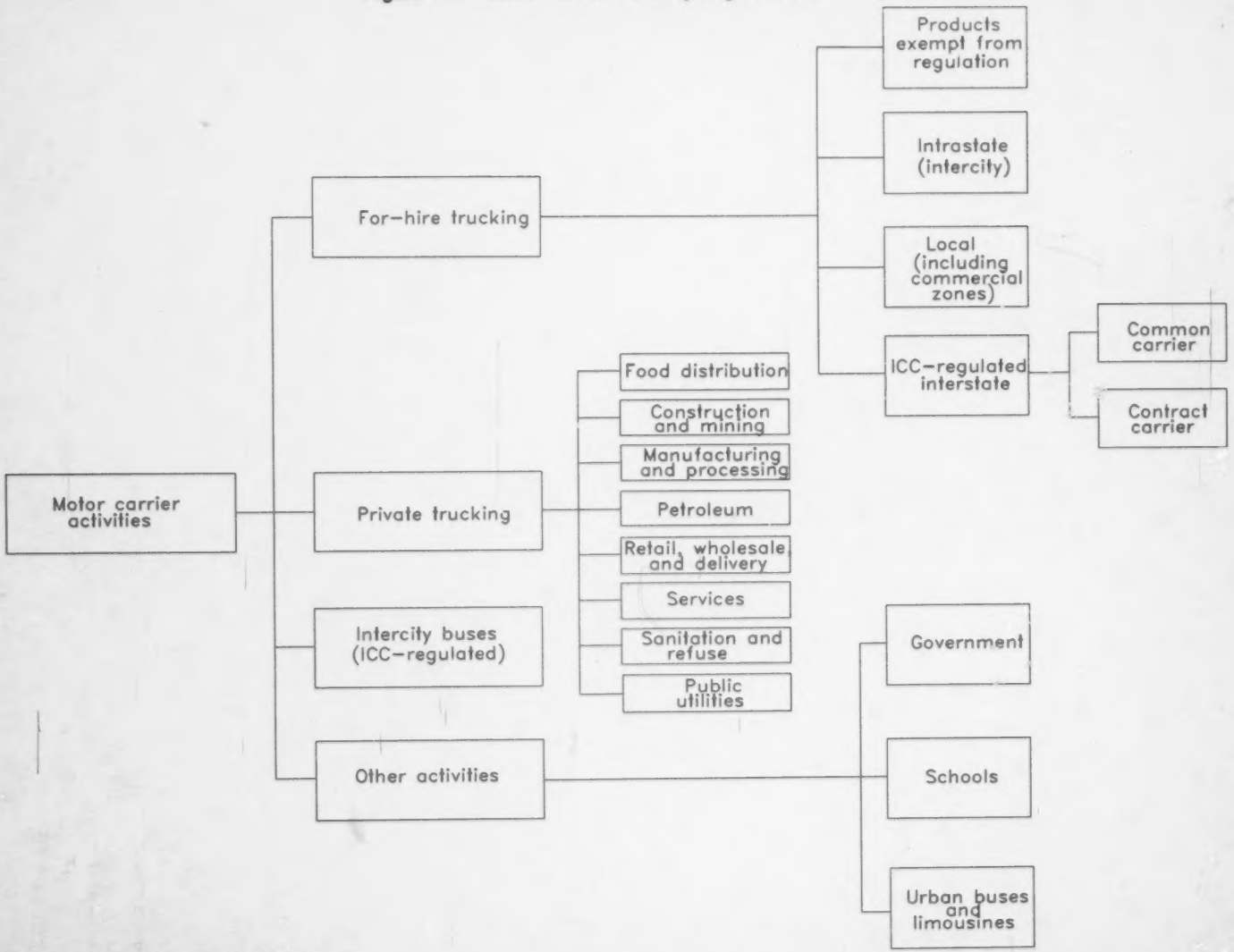
Each carrier has chosen methods that are most cost-effective for its individual operations, and no single best way of managing for safety emerged from OTA's examination. In equipment management, for example, some firms with good safety records keep their tractors for 7 or 8 years, undertaking major engine overhauls at 300,000 miles. Others choose to replace tractors at 4 years or 500,000 miles, finding maintenance too costly after that. Reflecting these varying decisions, over the past 8 years, the median age of heavy trucks in the commercial fleet rose from 6 years in 1978 to 7½ years in 1985, and has settled at about 7 years after strong sales in 1987. Large carriers are standardizing fleets to make maintenance more efficient and enable them to bargain hard with manufacturers for durability and maintenance-free characteristics in their large fleet purchases. However, companies with notable safety records do have in common a commitment to safety and to personnel and scheduling practices that indicate respect for the driver and his or her essential contribution.

The industry relies for economic success on high productivity gained by carrying large volumes in millions of single trips, meeting demanding time schedules, and keeping prices competitive. These business requirements do not make it easy to comply with complex and varying regulations imposed at different governmental levels. **OTA concludes that the economic success of a carrier has an identifiable effect on operations and fleet condition; in fleets having financial difficulties, vehicles are not as well maintained and equipment tends to be older. However, the absence of good data from the period before economic deregulation, the effects on all business activity of the 1982 recession, and the many changes in carrier operations that occurred as the result of other governmental policy decisions, all lead OTA to conclude that no clear link can be established between changes in economic regulation and motor carrier safety.**

HUMAN FACTORS

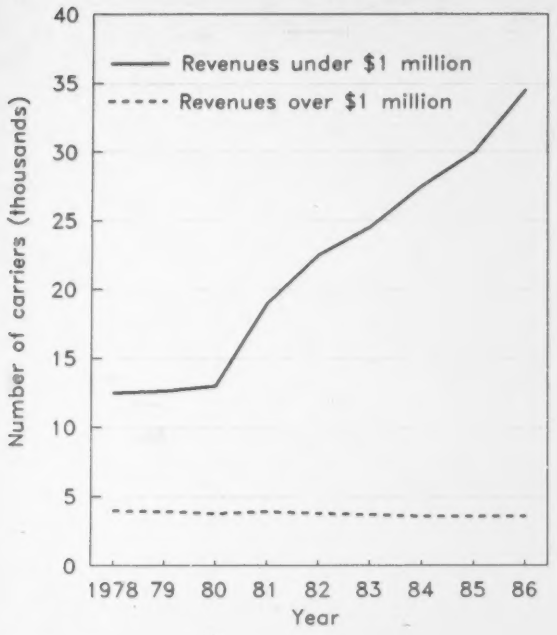
Accident data show that over 60 percent of accidents are caused by human error. While a good deal is known about the factors that degrade driving performance, **OTA concludes that Federal programs have not focused adequately on developing effective countermeasures.** Inexperienced drivers are particularly susceptible to accidents, and a large number of heavy truck drivers involved in accidents

Figure 1-5.—Motor Carrier Industry Organization



KEY: ICC = Interstate Commerce Commission.
SOURCE: Office of Technology Assessment, 1988.

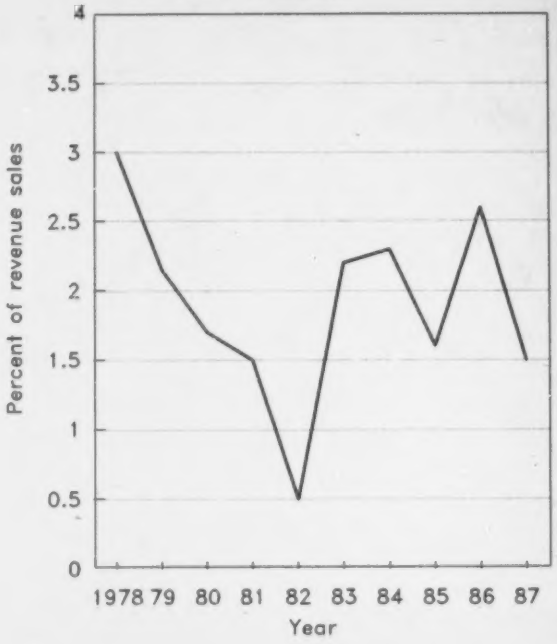
Figure 1-6.—Number of ICC Motor Carriers by Revenue Category, 1978-86



KEY: ICC = Interstate Commerce Commission.

SOURCE: Ronald Roth, American Trucking Associations, Inc., "Trucking: An Overview and Focus on Recent Times," unpublished manuscript, September 1987, chart 14.

Figure 1-7.—Net Profit Margin, 1978-87 (all carriers)



SOURCE: Ronald Roth, American Trucking Associations, Inc., "Trucking: An Overview and Focus on Recent Times," unpublished manuscript, September 1987, chart 25.

have poor driving records—including speeding offenses.

Training

A vital element in preventing accidents is the driver's skill and awareness; both can be increased through appropriate training. Surveys indicate that many heavy truck drivers have not received any formal driver training prior to going on the road, although many companies will hire only drivers with verifiable experience. OTA research shows that many drivers involved in accidents never had any training or significant retraining, and that level of driver training is frequently a factor cited on accident reports. **OTA concludes that special attention to training requirements and close scrutiny of the guidelines for the commercial driver's license test as they are developed by DOT are warranted. To ensure that training issues are adequately addressed, Congress may wish to require national guidelines for driver training and certification for truck driver training programs.** A consensus process for developing and approving the guidelines is important to ensure widespread acceptability. Participants could include officials from training schools, Federal and State regulatory and enforcement agencies, labor, carrier management, and vehicle manufacturers. A key issue is on-the-road experience required of prospective drivers, and to address this issue, **DOT might encourage carriers to develop apprentice programs that follow national guidelines.**

Considerable public and private effort will be necessary to make any new standards and programs effective, and the commitment of carrier management to safety and to implementing new standards will play pivotal roles. Historically, DOT has not been an active player in this area. **Congress may wish to encourage DOT to develop a cooperative government, academic, and private research, education, and outreach program to address management-**

related issues such as driver hiring, screening, and training programs and hours-of-service revisions.

Fatigue and Hours of Service

Research indicates that fatigue can play a major role in accidents, particularly for older drivers and for drivers on the road for 12 hours or more.[7] Moreover, drivers of large trucks have shown significant increases in driving errors and decreases in driver alertness due to fatigue during driving times that are well within the current hours-of-service limit. Greater understanding of the impacts on performance of circadian rhythm (time-of-day) and fatigue is needed so appropriate regulations and changes to driver scheduling can be developed. **OTA concludes that aggressive Federal research programs to address fatigue and sleep issues and to determine their role in truck accidents are top priorities.** DOT has planned several research projects on these subjects for the next 2 years; these projects represent small but important initial steps and deserve support and funding. However, followup will be essential if the research is to bring safety benefits.

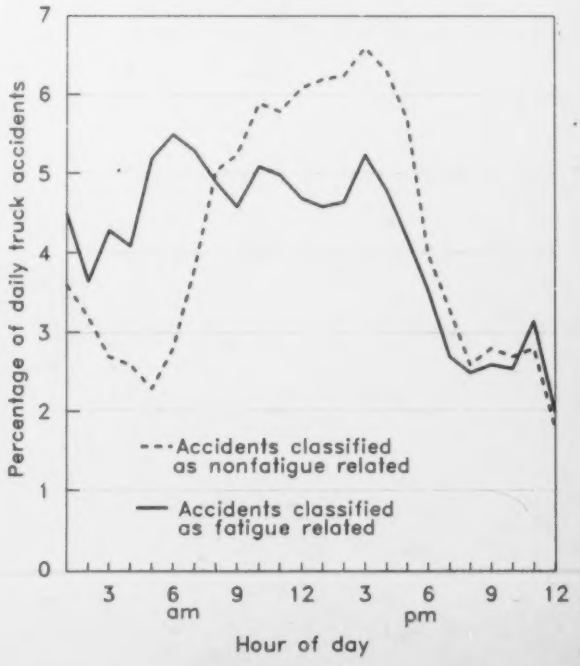
Many heavy truck operations are not conducive to allowing adequate rest for medium- and long-haul drivers. DOT hours-of-service regulations were formulated 50 years ago, and do not take into account the effects of operating on Interstate highways, new vehicle technologies, contemporary economic conditions, or advances in understanding of circadian rhythm, fatigue, and sleep needs. **OTA research points to compelling reasons for DOT to reexamine the hours-of-service regulations, and to develop revised standards based on current knowledge and the around-the-clock operating environment necessary today.**

Other driver-related factors, such as the effect of air quality and vibration in the cab environment on performance and fatigue, need consideration as well. An effective Federal research program on these subjects would require joint efforts by NHTSA and FHWA. Work to address these issues could also include cooperative government-industry studies to explore changes in cab and seat design and feasible scheduling alternatives and training programs. To ensure that all views are heard, independent drivers and representatives of large and small carriers should participate.

Accident Factors

Federal support for research on fatigue could also provide information to help management and drivers understand when drivers are most vulnerable to accidents and how scheduling and procedures might be altered to accommodate sleep needs (see figure 1-8). One practical and achievable outcome of such research would be simple, effective, and inexpensive techniques to screen drivers with sleep disorders, who are at high risk for fatigue-related accidents.

Figure 1-8.—Relationship of Driver Fatigue to Accidents, by Hour of Day

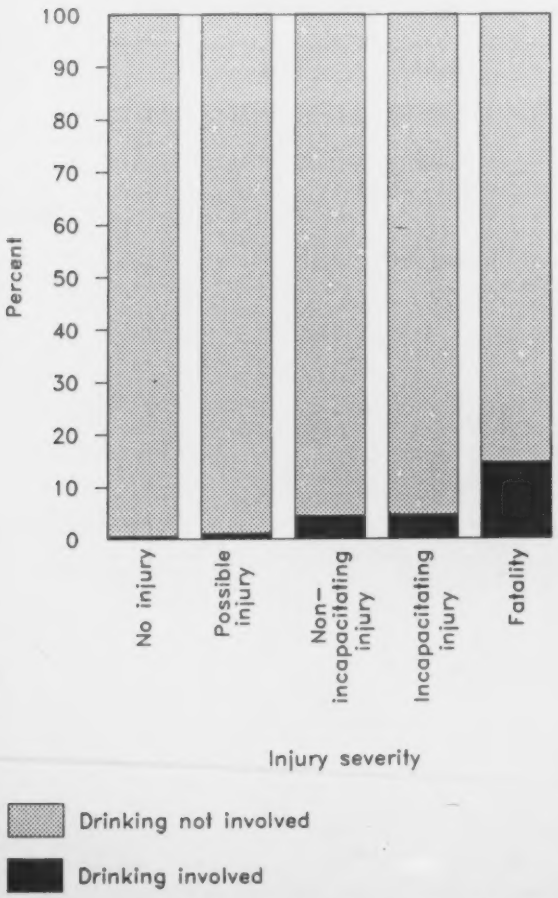


SOURCE: Office of Technology Assessment, 1988; adapted from K.D. Hackman et al. (eds.), *Analysis of Accident Data and Hours of Service of Interstate Commercial Motor Vehicle Drivers* (Washington, DC: U.S. Department of Transportation, Federal Highway Administration, August 1987).

[7]Patrick Hamelin, "Truck Driver's Involvement in Traffic Accidents as Related to Their Shiftworks and Professional Features," *Symposium on the Role of Heavy Freight Vehicles in Traffic Accidents* (Ottawa, Canada: Organisation for Economic Cooperation and Development, April 1987), vol. 2, pp. 3-107.

Drivers under the influence of alcohol are far more likely to have a severe accident (see figure 1-9). Abundant evidence indicates that truck driver performance is impaired by blood-alcohol concentration (BAC) levels well below 0.10 percent and that alcohol and drug use increases both the likelihood and severity of accidents. **Congress may wish to ensure that acceptable BAC levels for truck drivers are set at 0.04 percent, the current level for airline pilots, and to require drug and alcohol screening for all driver applicants, as part of periodic DOT-required physical examinations, and for probable cause.** Research is under way at the National Transportation Safety Board to document truck driver activities for 72 hours prior to a fatal accident to determine drug use and to try to establish impairment levels related to that use. Since a record of previous violations is characteristic of many truck drivers involved in serious accidents, Congress may wish to monitor closely DOT's future decisions related to violations during part-time activities or while off duty.

Figure 1-9.—Injury Severity in Heavy Truck Accidents Relative to Truck Driver Drinking



SOURCE: Office of Technology Assessment, 1988; based on National Accident Sampling System data, 1981-85.

On-Board Computers

On-board computers that record speed, stopping times, brake applications, etc., are management tools that many carriers have used successfully to improve the efficiency of their operations and to hold drivers accountable for their performance. Several carriers requested permission from DOT to substitute records from these computers for driver logbooks, and DOT has ruled that the devices are acceptable. Requiring the devices as a safety measure to improve compliance with the hours-of-service regulations has also been suggested.

In companies where on-board computers are used, fleet managers introduced the devices only after careful dialog with drivers to minimize potential adverse reactions. Many owner-operators view the devices as intrusive and cannot find benefits that justify investment in them. **OTA concludes that while a Federal requirement for on-board recording devices may be premature, Congress may wish to require DOT to plan and implement a program leading toward such a rule. Preparation and education for management, labor, and State enforcement officers are essential to ensure acceptance of these tools as safety devices, prevent their abuse, and assure their usefulness in increasing industry compliance with regulations.**

Public Education

Finally, education programs directed at motor carrier and automobile drivers could enhance awareness of safety issues related to sharing the roads. These programs should focus on the handling and stability characteristics of trucks, the need to maintain adequate distance between vehicles, the longer distances required for a heavy vehicle to stop, and the severe damage that can result from a collision between cars and trucks. **Congress may wish to re-**

quire NHTSA and FHWA to play mutually supportive roles in developing a model program for States to ensure that these messages reach a broad population. Information programs could be incorporated into the process for obtaining and renewing driver licenses.

VEHICLE AND ROADWAY TECHNOLOGIES

While highway system design issues and truck vehicle safety technologies are inextricably linked, they are treated as two separate issues by governments, by carriers, and by vehicle manufacturing industries. Moreover, while data point clearly to vehicle technology problems that have identified technical fixes, only a handful of researchers have devoted similar attention to highway design issues as they affect operation of wider and longer heavy trucks. **OTA finds that a systems approach to commercial vehicle highway safety is a priority for Federal action. DOT agencies, including NHTSA and OMC and highway planning, safety, and design offices in FHWA must work more closely with each other and with industry to address driver, vehicle, and road safety issues systematically.**

Speed and Highway Design

Federal and State accident databases cite "speed too fast for conditions" most frequently as a factor in truck accidents. To determine the appropriate speed for conditions, the driver must understand the operating limits of his vehicle and the configuration of the specific section of the roadway on which he or she is traveling. For example, accident analyses show that a disproportionate share of fatal heavy truck accidents occur on U.S. and State highways, roads usually constructed with lane widths and median markings appropriate for automobiles. Light conditions, weather, and traffic congestion are not major contributors to such accidents. Reconstructing these highways to increase width, passing lane length, and sight distances, and to provide sturdy median barriers would be prohibitively expensive. Thus, the driver, as he or she assesses the appropriate speed and controls the vehicle, is the primary accident prevention tool.

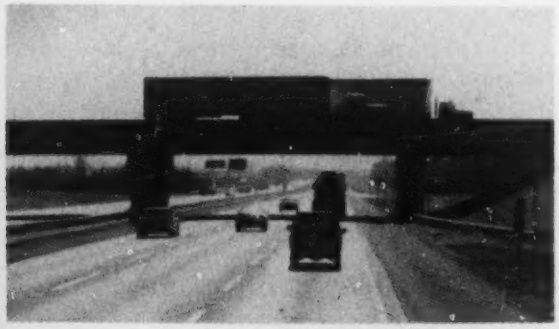


Photo credit: Michael Hines, OTA staff

Heavy trucks travel all types of roads, although most roads were designed for automobiles.

Industry approaches to limiting and controlling vehicle speed vary widely. Some companies train drivers how to operate according to explicit corporate speed policies, and design driver schedules so that trips can be accomplished within the legal duty shift. Other large trucking companies install speed governors set at roughly 57 miles per hour (mph) on their fleets, finding that the need to balance fuel efficiency, safety, and delivery schedules is best met by this method. Still other companies have installed on-board computers to monitor driver speed. On the other hand, many truck drivers, including some employed by large companies, own radar detectors and consider them essential to accomplishing the on-time deliveries required of them by shippers or brokers.

Congress may wish to consider legislation to require speed control devices, such as governors or other devices that measure and record speed only, as tools to control and monitor speed and aid enforcement. In addition, since the primary reason for radar detectors is to alert a driver when the vehicle's speed is being monitored to see whether it is exceeding the speeding limit, Congress may wish to make such devices illegal for all vehicles across the country. Also, model standards for penalties for speeding that are high enough to be a deterrent to violators could be developed.

A reexamination of highway design standards with an awareness of the size of today's heavy trucks

could lead to **relatively low-cost safety improvements—revised signs to assist drivers of heavy vehicles in accurately assessing the appropriate speed for roadway limits. Also of importance are revisions to ramp design, intersection, and other roadway standards.** While these are long-term processes and reconstruction of roadways will take longer still, Federal efforts could be intensified to assist States in determining appropriate new standards.

Further, in light of the important role of speed in fatal accidents, Congress may wish to reexamine the decision to permit truck speeds of 65 mph on rural Interstate highways. Data analysis for this study leads OTA to conclude that the importance of keeping trucks at speeds compatible with highway design and roadway conditions outweighs any small economic advantages that might accompany faster carrier travel.

Brakes

Defective brakes are the most prevalent vehicle violation uncovered by roadside safety inspections. In addition to brake wear and adjustment problems that affect buses and straight trucks, brake compatibility between tractors and the trailers they pull poses major difficulties. One result of incompatibility between tractor and trailer brakes is a high potential for jackknifing. Bobtails (tractors running without a trailer) and combination trucks running empty pose particular difficulties because of the complicated relationship between brake systems and truck loads. **OTA concludes that overcoming brake incompatibility between tractors and trailers and other brake-related problems are priorities for manufacturers and carriers. Furthermore, active participation by NHTSA is necessary to bring early results and improved standards for brake system components.** Trailer manufacturers as well as tractor makers must be involved in the rulemaking process to ensure the development and use of compatible and well-balanced braking systems. **An all-out joint effort by OMC, NHTSA, the trucking industry, and tractor and trailer manufacturers to address this issue is urgently needed.**

Another essential step in addressing brake problems is completion of current DOT tests on antilock brake systems to verify their effectiveness under field conditions. Manufacturers are beginning to test

Photo credit: Commercial Vehicle Safety Alliance

Brake defects such as this are the most frequent equipment violations found during roadside inspections.

tractor-only antilock systems, on the premise that these are currently the most feasible for the complex and diverse U.S. trucking industry. **If the DOT tests are successful, antilock systems could become mandatory equipment by the early 1990s. Key components to successful implementation of the requirement include: 1) lead time for development of standard procedures for mechanics for maintaining and adjusting the brake system, and 2) education and training programs for operators and mechanics to disseminate accurate information on checking and adjusting brakes for varying loads. Full tractor-trailer antilock systems remain the eventual safety goal.**

Equipment Standards

Handling and stability problems increase the likelihood of rollover, particularly for operations involving tractors and double trailers. Tire condition and

performance are also key factors in safe operations. Additionally, lethal override/underride accidents, particularly at night, indicate a need for devices to mitigate the effects of these accidents and to make trucks more visible at night. **OTA concludes that NHTSA has lagged badly in proposing upgraded standards in several of these areas. Congress may wish to require NHTSA to move vigorously on rulemaking.**

The Federal Government could play a more active role in determining standards for safety technologies, either as *performance criteria* (which state minimum acceptable capabilities) or as *design standards* (which detail the equipment that must be used).[8] Vehicle equipment compatibility issues are so difficult that a cooperative Federal effort by OMC (FHWA), NHTSA, and industry is needed for solutions.[9] For example, some of the FHWA brake standards are incompatible with NHTSA requirements. As new equipment becomes standard, mechanics will need training in proper techniques and tools. Cooperative industry-government efforts will be especially useful in developing and implementing education and training programs for mechanics to ensure that both new and old systems are maintained properly.

Manufacturers and researchers have experimented with and evaluated splash and spray control methods and devices. Tractor manufacturers have been working on aerodynamically shaped tractors and side deflectors and dams for trailers; one side-benefit is increased splash and spray control. **OTA concludes that NHTSA moved prematurely to close its rulemaking for this problem, and that performance criteria could be developed and phased in for new equipment, based on available knowledge.**

Truck occupants typically do not wear safety belts that can protect them from ejection or hard contact with the cab interior, which can cause serious injury or a fatality. **OTA concludes that a requirement that drivers use three-point seat belts when operating their vehicles could contribute to driver survival.** The implications of cab design and cab equipment location are important subjects for a continuing Federal program of cab crashworthiness research.

Difficulty in designing retrofit equipment adaptable to older vehicles and the evolutionary nature of technology focus manufacturers' R&D efforts toward new vehicles.[10] New requirements for safety equipment concern large firms and individual owner-operators, since refitting and modifying existing fleets or vehicles can have significant costs. Without regulation, industry will balance the degree of benefit against the effort and cost involved in retrofitting a vehicle to determine whether to adopt safety equipment.[11] **Given these difficulties, Congress may wish to require DOT to develop implementation programs for regulations that require retrofits with new technologies.**

The relative operating safety of single and double combinations has been studied extensively, but major differences have not been established, nor could OTA identify significant variation in its own research. Moreover, after an initial learning and adjustment period for doubles operations, fleet owners have found the safety record for both types of operations to be very similar. **OTA concludes that different safety problems are inherent in each design and that appropriate driver training and experience with each can improve operational safety.**

Finally, the cost of educating drivers to use new safety equipment is one that will have to be accounted for in some fashion by the marketplace. Although carriers may need to pay drivers and mechanics more for having technological skills, some of the costs will be offset by reduced accident and insurance costs.

Adopting New Technologies

Since many safety improvements do not translate directly into higher productivity, industry acceptance of new technologies is slow. The fragmentation of the industry hampers dissemination of safety information on new technologies, and legislative and rulemaking processes required to implement new

[8]Joe R. Morris, "Safety Implications of Changes in Truck Size and Weight Limits," *Symposium on the Role of Heavy Freight Vehicles in Traffic*, op. cit., footnote 7, vol. 3, pp. 4-14.

[9]Robert Ervin, University of Michigan Transportation Research Institute, in U.S. Congress, Office of Technology Assessment, "Transcript of Proceedings—OTA Workshop on Technologies Affecting Truck Safety," unpublished transcript, Mar. 10, 1987.

[10]P.A. Gustafson, Cummins Engine Co., Inc., personal communication, Apr. 28, 1987.

[11]Farrel L. Krall, Navistar International Corp., personal communication, Apr. 29, 1987.

technologies are complex and time-consuming. Although the number of participants may be large (see figure 1-10), government-industry working groups that focus on setting uniform standards, voluntary field testing by industry, and the sharing of experimental data can lead more quickly to acceptable new standards.

OTA concludes that Federal education and information programs are essential if requirements for new technologies are to be implemented quickly. Congress may wish to allocate resources and require DOT to undertake such tasks. For example, widespread misunderstanding by operators and some maintenance personnel of how truck brake systems should be installed, adjusted, and maintained, suggests a need for a nationwide education program. Training programs for maintenance personnel are a top priority.

Trade associations and publications could well take the lead in educating carriers, while States could coordinate such measures with their enforcement programs and with State trucking associations. The industry members hardest to reach with such efforts are the owner-operators, since many do not participate in large industry groups. Establishing video instructional displays at truck stops around the country is one method of informing carriers and drivers of the risks they take by operating trucks with deficient brakes. Ways to avoid and correct safety problems can also be presented at such displays.

The adoption of safety-related technologies by trucking firms and owner-operators is not an automatic process. Improved safety equipment that has clear economic benefit may be quickly utilized by industry.[12] Many firms that can benefit from a particular safety technology (e.g., brake retarders for firms that operate frequently over mountainous routes) have already taken steps to adopt it.[13] However, the economic benefit of safety equipment is not always apparent to industry. **OTA finds that in this situation, setting Federal performance standards for equipment through rulemaking, and ensuring that the standards apply equally to all motor carriers, regardless of classification, is appropriate.** Rough estimates of the costs of new safety equipment may be found in table 1-2.

[12]Brian O'Neill, Insurance Institute of Highway Safety, in Office of Technology Assessment, op. cit., footnote 9, p. 109; and Ernie Vaughn, Owner-Operators Independent Truck Drivers Association, in Office of Technology Assessment, op. cit., footnote 9, p. 33.

[13]William Leasure, National Highway Traffic Safety Administration, in Office of Technology Assessment, op. cit., footnote 9, p. 170.

Table 1-2.—Estimated Costs of Safety Equipment for New Vehicles

Equipment option	Cost per vehicle[a] (1988 dollars)
Tractor:	
1. Three-point seat belts	50
2. Antilock brakes	2,100
3. Brake adjustment indicators and automatic slack adjusters (front axle)	150
4. Brake adjustment indicators and automatic slack adjusters (rear axle)	280
5. Splash/spray suppression	300
6. Reflectors	15
Tractor total	2,895[b]
Trailer:	
1. Conspicuity devices	125
2. Side underride guards	1,000
3. Automatic slack adjusters	450
4. Brake adjustment indicator	150
5. Antilock brakes (not currently offered in U.S.)	1,200
6. Splash/spray suppression	300
7. Rear underride guard	100
Trailer total	3,325[c]

NOTE: The Nation's registered tractor/trailer fleet included 1.1 million truck-tractors and 3.4 million trailers in 1986.

[a]Average or mid-range cost based on current production levels.

[b]Represents a 3 percent addition to tractor cost, based on $88,500 average tractor cost for 1987.

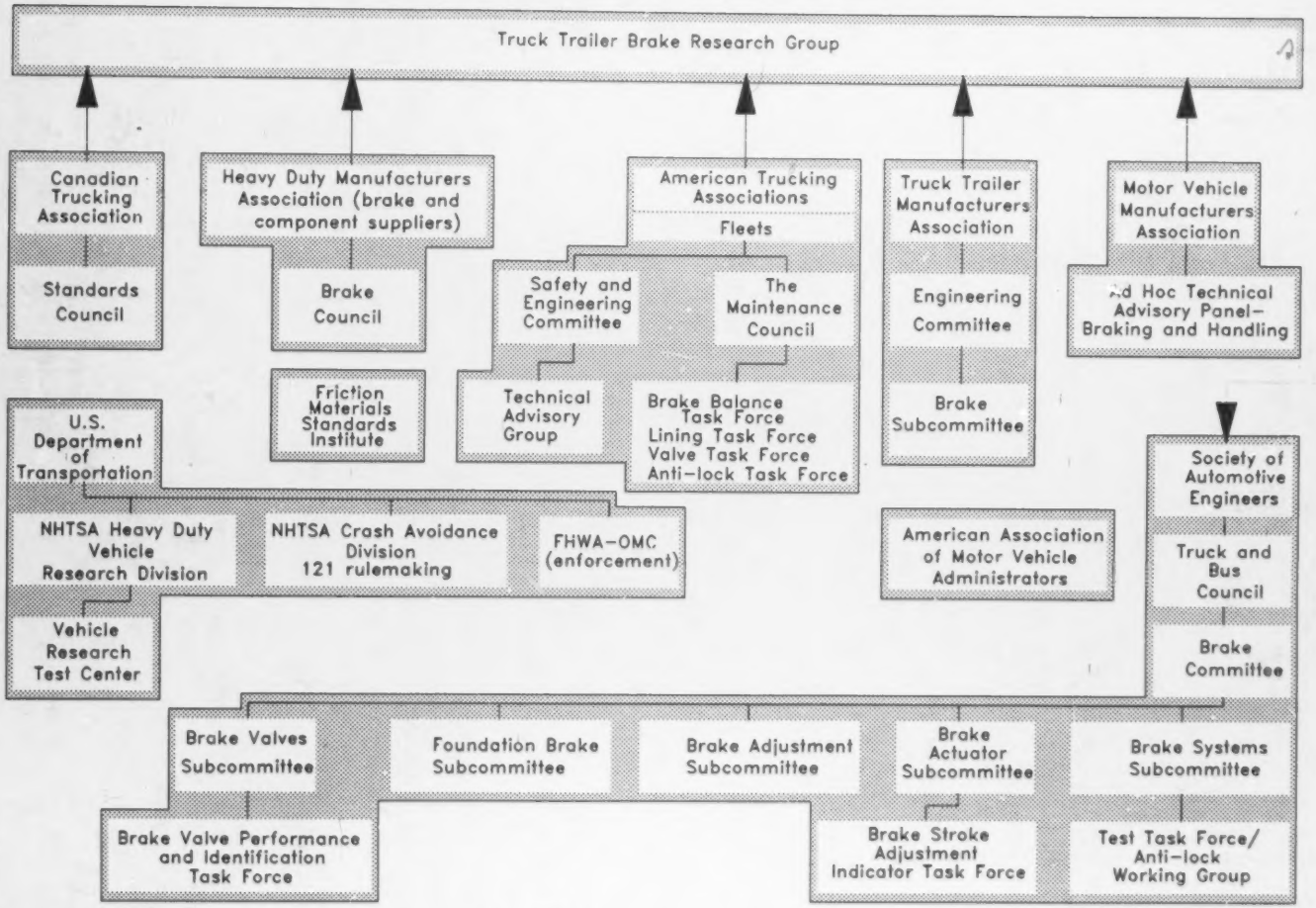
[c]Represents a 30 percent addition to dry van trailer cost, based on $11,000 average trailer cost (closed-top, dry freight van) for 1987.

SOURCE: Office of Technology Assessment, 1988; based on estimates from the American Trucking Associations, National Highway Traffic Safety Administration, U.S. Department of Commerce, Bureau of the Census, Motor Vehicle Manufacturers Association, and several trailer manufacturers, August 1988.

GOVERNMENTAL COORDINATION

Congressional mandates and DOT actions since 1980, such as requirements for annual vehicle inspections and more stringent standards for driver licensing, represent steps toward greater safety. A comprehensive national truck safety program requires continuing such programs and establishing

Figure 1-10.—Organizations Concerned With Brake Standards



KEY: NHTSA = National Highway Traffic Safety Administration; FHWA = Federal Highway Administration; OMC = Office of Motor Carriers.

SOURCE: Office of Technology Assessment, 1988; based on information from the American Trucking Associations, 1987.

a far more systematic Federal-State approach. **OTA concludes that two issues are top priorities: 1) improving State enforcement capabilities and regulatory uniformity, and 2) better coordination and cooperation among agencies within DOT.**

State Issues

MCSAP has firmly established the role of States as an essential adjunct to Federal safety efforts. **Continued Federal financial support for State inspection and enforcement activities through MCSAP is crucial. Because additional trained personnel are needed across the country, Congress may wish to increase funding for this useful program. Additional State activities could enhance safety in a number of areas.**

Monitoring industry through terminal audits and ensuring the safety fitness of all motor carriers are important components of a systematic safety program. DOT has made some progress in assigning fitness ratings to the large numbers of unrated motor carriers, mostly small operators, who entered the trucking industry after deregulation. However, the safety fitness of the private fleets that provide over half of commercial truck transport must also be evaluated, and Federal personnel levels are inadequate for this task. Because State audit programs are indispensable additions to Federal enforcement efforts, **Congress may wish to require DOT to develop guidelines and handbooks for States and to encourage more States to train inspectors and begin auditing carriers.** Efforts by FHWA to improve regulatory compliance materials for industry would be helpful as models for the States as well.

OTA concludes that industry complaints about inconsistent State inspection and enforcement procedures and penalties are symptoms of the need for stronger Federal and State efforts toward national uniformity. The Commercial Vehicle Safety Alliance's (CVSA) goal of establishing uniform inspection and out-of-service criteria provides an excellent model for States to use in working together toward consistent nationwide programs. However, efforts will be ineffective unless State governments make the commitment to have all their own agencies cooperate toward this goal. Moreover, intrastate motor carrier operators are subject to uniform safety controls only if Federal regulations have been adopted and are enforced by the States. **Congress may wish to consider requiring all States to participate in MCSAP and adopt and enforce Federal regulations.** To assist in resolving current conflicts in State agency agendas, strong DOT support for consistent implementation of enforcement programs will be needed once FHWA's review of State laws and regulations has been completed and State safety laws evaluated.

Congress may wish to require DOT to provide technical assistance and information on safety regulations and enforcement issues for State officials, law enforcement personnel, and judges. Educational materials could be distributed to States and motor carriers on: 1) Federal safety requirements, 2) model programs for amending laws, 3) implementing Federal standards, and 4) developing an information clearinghouse. An enforcement handbook could provide general guidance on the safety regulations and safety factors to consider when setting penalty amounts for various types of violations. Involving State executive and legislative bodies, bar associations, and enforcement organizations, such as State Attornies General and police chiefs, in the process could help gain acceptance from all agencies of the need for a uniform approach.

DOT has issued a rule, effective in November 1988, eliminating a long-standing regulatory loophole—the Commercial Zone Exemption as it applies to safety regulations in large urban regions. **Congress may wish to ensure that this and other safety exemptions are eliminated completely and quickly.** State and local enforcement officers will need capability to monitor and enforce safety requirements for commercial vehicles in urban commercial areas.

The public safety requires that motor carrier safety regulations are independent of commodity, corporate form, type of operation, or destination of the cargo—the traditional bases of regulation and often the bases for exemptions. Trucks operating in intrastate, private, government, and exempt services perform a major share of the Nation's motor carrier transportation. While safety regulations have gradually been extended to these carriers, **OTA concludes that a comprehensive heavy vehicle safety program must extend safety regulations to all heavy vehicles and operators in all States. The need for safety does not vary with the type of**

operation, and no exemptions from safety regulations, including the Commercial Driver's License, are warranted.

Access

The motor carrier industry is a focal point for many conflicting demands. Shippers, especially those of bulky lightweight products, such as packaged foods or paper goods, push for larger trailers to carry more goods—at minimal extra cost. To capture this business, carriers have purchased new trailers larger than drivers are accustomed to, and joined shippers in convincing State legislatures that trailers as long as 53 feet can operate safely on State roads.

In the Motor Carrier Act of 1984, Congress made clear that decisions on access to State roads for large trucks are the province of the States, not the Federal Government. Resolving the conflicts inherent between industry's push for larger and longer vehicles and the limitations of the Nation's road network requires Federal and State officials to work closely with each other and with shippers and carriers. States have found developing routes and communicating access decisions clearly to industry to be complex and difficult tasks, requiring hard work, patience, good will, and good humor from all parties. Where the process has failed, carriers travel on the routes they deem necessary to reach their destinations, often using narrow rural or urban roadways that are unsuitable for the large vehicles and violating State law.

OTA concludes that varying State access, inspection, and enforcement policies pose significant problems for industry and can adversely affect highway safety when drivers detour on back roads to avoid the delays that often result. Congress may wish to require DOT to play a more active role in facilitating State-industry dialog and resolving these difficult issues. Technology transfer for innovative solutions and working actively with appropriate State and industry organizations are two possible approaches.

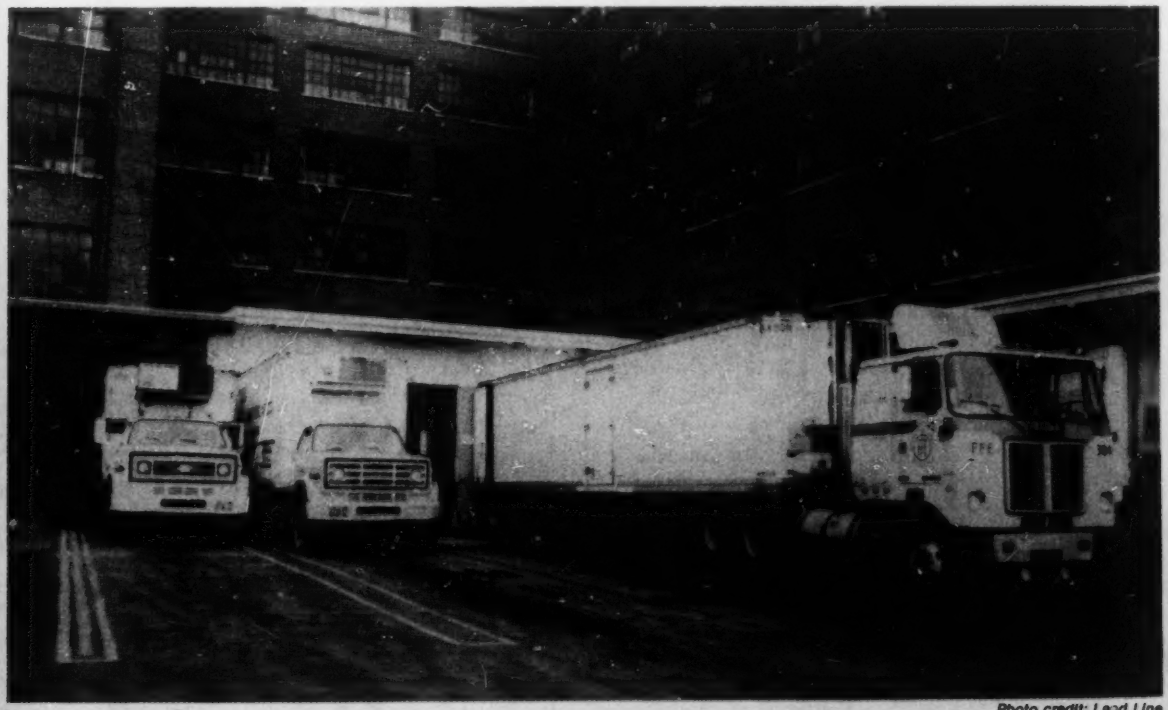


Photo credit: Land Line

States determine which roads heavy trucks may travel to reach terminals such as this one to pick up and deliver goods in urban areas.

DOT Programs

OTA finds that the division of responsibility for different facets of roadway, vehicle, and driver issues among multiple agencies hampers safety problem solving within DOT. To be able to respond effectively to congressional safety directives, DOT will need to coordinate its agencies. DOT's program to implement the commercial driver's license requirement is a commendable exception; it could serve as a model for efforts to deal with equipment requirements and highway design issues. **Congress may wish to require DOT to develop a plan to integrate the technical expertise now divided between NHTSA and the motor carrier and highway design sections of FHWA to address issues such as roadway and vehicle compatibility guidelines, upgraded safety equipment standards, national training guidelines for drivers and maintenance personnel, accident reduction and mitigation strategies, and data collection and analysis.**

OTA further concludes that DOT agencies need to coordinate in collecting and analyzing data, conducting research programs, and developing regulatory proposals. Although NHTSA and OMC in FHWA do review some of each other's research projects, this is the exception rather than the rule. Establishing special working groups to address issues of common concern, jointly funding research activities, and sharing staff expertise are examples of strategies that could be used.

SAFETY DATA RESOURCES

Accurate, uniform, and representative information that gives sufficient detail for analysis is essential for informed policy decisions on motor carrier safety issues. Objective data are needed to identify highway design limitations and problems and to evaluate the point at which technologies are reliable and cost-effective. **However, OTA concludes that, with few exceptions, existing heavy truck data and information resources have deficiencies that limit their value in supporting safety policies and programs.** In general, Federal data collection suffers from lack of uniformity, some duplication, inadequate quality control, poor handling, and outdated storage systems. **Furthermore, OTA finds that no effective central DOT analysis capability exists, and that this deficiency seriously hinders DOT's policymaking. Congress may wish to require DOT to establish such a centralized capability and develop a comprehensive program to gather, review, and analyze relevant data.** Although some of the existing data are useful for analyzing particular truck safety issues, none of the national accident databases is ideally suited for addressing all truck safety issues (see table 1-3).

NASS, NHTSA's major data source, includes accident data from 1981 to the present. NASS selects accidents, based on a statistically based sampling scheme, permitting the derivation of estimates for national accident totals and annual trends. Changes made to NASS for 1988 are likely to make it more difficult to conduct detailed truck and bus accident causal studies using this database.

State accident reporting systems present several promising alternatives because they can represent a census of accidents. However, the lack of uniformity among State data presents problems for extrapolating findings to the national level. The efforts of NHTSA in establishing the CARDfile, and of FHWA working with CVSA and the National Governors' Association in striving for more uniform State accident reporting practices are commendable efforts to address this issue.

A NASS-style approach focused on heavy vehicles could be a cost-effective prerequisite to a truck and bus accident data system, for it allows a sampling of operations by both geography and road use. To provide accurate and comprehensive information, each accident investigation could be handled by field staff that examines the vehicle and the accident site, interviews vehicle occupants, and reviews medical and driver records. For this option to be realized, additional funds will be needed both to restore the original approach and to expand the system to meet truck safety concerns, including training of field teams in truck accident investigation.

FHWA currently has a uniform data collection demonstration project under way in the midwest. FHWA could work actively with other States to expand accident report forms to accommodate truck

detail and to establish uniform reporting thresholds and forms for data elements. Both of these developments would enhance truck safety information and furnish a statewide census of accident history. NHTSA's advice and expertise would be invaluable, regardless of which agency took the lead.

The cost of either an accident or an exposure data collection program is a function of the desired precision in the estimates. Close to 300 sampling units would be required to achieve reasonable confidence levels for determining accident rates for different truck types, at a total annual cost of close to $2 million. In addition, the logistical demands of establishing and maintaining cooperative arrangements with each jurisdiction are formidable. More economical alternatives include continuing and expanding existing data collection instruments, although their deficiencies are likely to persist. Given the massive scale of trucking activity, and the comparatively detailed safety information available for air, rail, and marine transportation, these are important tradeoffs to consider.

OTA finds that uniformity between accident and exposure data, and accuracy in estimating truck movements (see tables 1-3 and 1-4) are priority needs. Congress may wish to consider extending FHWA's reporting requirements to include an annual report from all motor carriers, including intrastate operators and those currently exempt from Federal reporting requirements. Information could include the number of trucks owned and miles traveled. To keep track of heavy vehicles, a Federal-State cooperative truck registration database could be developed in conjunction with State vehicle registration requirements. An FHWA database such as SAFETYNET could be used if modifications to the system can be made.

Inspection and Enforcement Data

Under MCSAP, a wide range of State inspection and enforcement data is being amassed that provides useful information for safety analyses. Although the process by which vehicles and companies are targeted for inspection varies between States, the inspection results are reported in a uniform way. SAFETYNET, the enforcement database developed for MCSAP, must mature before its information can be available in an automated form on a national scale, but at that time it will be a valuable resource.

Additional DOT technical assistance for State agencies in developing more uniform data management systems and analytical capabilities, especially in tracking preventable accidents and violation statistics, would be an effective use of limited funding. States could use this information to target carriers for audits and inspections. As FHWA and ICC implement new procedures for assessing the safety fitness of commercial vehicle operators, explicit procedures for monitoring ongoing safety performance will be needed. State personnel and FHWA field inspectors alike could benefit from consistent guidelines for deciding whether to initiate a compliance education program or an enforcement action.

Market Entry, Exit, and Financial Performance

Little public data is available on the financial performance of the industry, and ICC has required less and less reporting over the past 8 to 10 years. **OTA concludes that the ICC reporting system has dwindled to a point where it no longer adequately monitors carrier market entry, exit, and financial performance. The current lack of information presents a significant problem for both safety-related and broad policy decisions.** Obtaining sufficient information would require a dramatic reversal of ICC policy to include Class III carrier registrations, requests for exemptions, and sufficient detail in the data elements to track some degree of financial performance. Substantial data will be needed to restore this system so that it serves a useful purpose for evaluating truck safety. Congress may wish to require ICC to collect such data or place responsibility for doing so with DOT as part of a national motor carrier safety program.

Table 1-3.—Truck Safety Information Systems (Accident Data)

Database	Kept by	Years	Strengths	Weaknesses
50-T (part of MCMIS)	FHWA, Office of Motor Carriers	1973 to present	• Good detail on truck accident characteristics • Exclusive truck focus	• Missing several portions of the truck population • Concern over accuracy and completeness of reports • Relies on carrier participation
FHWA, Special Monitoring Study	FHWA, Office of Highway Information	1983 to present	• Involves accident and exposure data • Exclusive truck focus	• Restricted to aggregate accident reporting • Limited in terms of number of participating States • Missing some truck detail
NASS	NHTSA, National Center for Statistics and Analysis	1979 to present	• Statistical sampling design • Comprehensiveness of accident investigation • Reasonably good detail on truck accident characteristics • National estimates of accident frequency	• Small number of heavy truck accidents in database • Detailed causal analysis sometimes difficult
FARS	NHTSA, National Center for Statistics and Analysis	1975 to present	• Census of all fatal accidents • Comprehensiveness of accident investigation	• Limited details on truck configuration and operation • Nonfatal accidents not represented
NTSB	NTSB	1986 to 1987, single collection	• Comprehensiveness of accident investigation • Good detail on truck characteristics • Exclusive truck focus	• Limited sample of accidents under investigation, not representative of truck crashes generally
State databases	Various State regulatory agencies		• Census of all accident types	• Based solely on police reports at scene • Varying detail on truck accident characteristics • Lack of uniformity from State to State
CARDfile	NHTSA	1982 to present	• Census from several States • Uniformity in reporting format	• Limited truck detail due, in part, to limited uniform variables listed • Based solely on police reports at scene • Limited to a few States
Motor carrier industry	Individual carriers, trade associations		• Some individual carriers maintain excellent detail on accidents and movements • Exclusive truck focus	• Individual carrier represents single observation in industry • Access to individual carrier records is not in the public domain • Trade associations report accident rates but not details on accident characteristics
Insurance companies	Individual companies, ISO		• Detailed financial and statistical data on truck insurance policies and claims	• Aggregate reporting of information by insurers • Primary concern over loss ratio rather than accident causation
UMTRI	UMTRI	1980 to present	• Combines coverage of FARS with detail of 50-T • Post-accident investigation to complete missing information • Exclusive truck focus	• Reliance on information provided by carrier during post-accident investigation • Restricted to fatal accidents

KEY: MCMIS = Motor Carrier Management Information System; FHWA = Federal Highway Administration; NASS = National Accident Sampling System; FARS = Fatal Accident Reporting System; CARDfile = Crash Avoidance Research Datafile; NTSB = National Transportation Safety Board; NHTSA = National Highway Traffic Safety Administration; ISO = Insurance Services Offices, Inc; UMTRI = University of Michigan Transportation Research Institute.

SOURCE: Office of Technology Assessment, 1988.

Table 1-4.—Truck Safety Information Systems (Exposure Data)

Database	Kept by	Years	Strengths	Weaknesses
TIUS	Bureau of the Census	Every 5 years, most recently in 1982	• Covers all trucks used in the United States • Sample biased toward heavy trucks • Exclusive truck focus	• No commodity flow data • Only rudimentary commodity information • Reflects tractor use, not trailer use • Based on owner response
CTS	Bureau of the Census	Since 1963, every 5 years	• Multimodal • Cross-checked against the Census of Manufacturers • Provides flow data	• Shipment data on some products are missing • Only shipments from point of manufacture to first destination are reported • Nonuniformity between surveys • Voluntary data submission
Motor Carrier Census File (part of MCMIS)	FHWA	Most recent 5 years	• Comprehensive listing of carriers and truck fleet operators • Exclusive truck focus	• Many carriers missing from database • No commodity flow data
HPMS	FHWA	Annually	• Statistical sampling design • Detail on roadway characteristics	• Limited truck classification detail
TWS	FHWA	Annually	• Truck classification and weight data • Exclusive truck focus	• Counting sites are not statistically representative • Method of data collection varies and is subject to observer error
Motor carrier industry	Individual carriers, trade associations		• Aggregate statistics on tons, ton-miles, and truck registrations • Detailed flow records from individual carriers and shippers; can merge with similar accident records • Exclusive truck focus	• Truck data are based principally on LTL carriers • Individual carrier represents single observation in industry • Access to individual carrier records is not in public domain
NMTDB	Transportation Research and Marketing (consulting firm)	1977 to present	• Focuses on long-distance truck movements • Good truck and operator classification detail • Exclusive truck focus	• Purposely excludes short-haul truck movements, especially in Northeast • Not in public domain
NTTIS	UMTRI	1986 to 1987, single collection	• Good truck and operator classification detail • Disaggregate and aggregate analysis possible • Exclusive truck focus	• Relatively small number of observations • Single collection

KEY: TIUS = Truck Inventory and Use Survey; CTS = Commodity Transportation Survey; MCMIS = Motor Carrier Management Information System; FHWA = Federal Highway Administration; HPMS = Highway Performance Monitoring System; TWS = Truck Weight Study; LTL = less-than-truckload; NMTDB = National Motor Truck Data Base; NTTIS = National Truck Trip Information Survey; UMTRI = University of Michigan Transportation Research Institute.

SOURCE: Office of Technology Assessment, 1988.

CARRIER ISSUES

Trucking is a tremendously complex industry with numerous market segments; each is served by a variety of motor carriers, making generalizations difficult. Changes in the economic regulation of the motor carrier industry had sweeping effects on market entry, operations, costs and pricing, employment policies and labor relations (including wage levels), and technology development. The distinctions between various types of regulated motor carriers have greatly diminished since deregulation, and entry opportunities for private carriers and owner-operators have increased.

The nature and volume of the business conducted by various segments of the trucking industry have also changed. The largest general commodity carriers now tend to specialize in less-than-truckload (LTL) shipments (under 10,000 pounds). Many large LTL carriers have failed since deregulation, and few new ones have entered the market. However, several of the largest nationwide LTL carriers have expanded and prospered, concentrating business in this segment. These firms compete fiercely for market share.

At the same time, the interstate truckload (TL) industry has become more diverse and dispersed. New entrants in the TL segment tend to be small and nonunion carriers, often from the ranks of owner-operators, who are a key part of this trucking fleet. However, to compete successfully as individual entrepreneurs, owner-operators must drive long hours and accept TL backhauls at low rates, circumstances that create physical, psychological, and economic hardships.

Factors are at work to tip the balance of TL operations toward larger carriers with more capital to invest. Successful TL operations currently stress high-quality service, using high-capacity, specialized equipment and utilizing their assets and labor productively to serve targeted market niches. Concerned about the reliability of leased equipment and drivers, carriers with sufficient resources buy their own equipment and employ company drivers. Others, such as automobile carriers, select and train drivers carefully to handle safely their highly specialized, complex equipment that is difficult to lease. Productivity is high enough that shippers pick these high-service carriers for both service and unit price, and they become "core" carriers, capturing a large portion of the TL freight from major shippers. Owner-operators face continued business pressure from these trends.

Photo credit: Karen Mathiasen, OTA staff

Automobile carriers train drivers to handle special equipment and valuable cargo.

Profits

Profit margins have fallen even for the most successful carriers, a product of intense price competition caused partly by changes in manufacturing and partly by continuing overcapacity. Carriers' expenses per ton-mile are up 75 percent since 1978, while revenues have increased only 54 percent. General freight revenues per ton-mile have increased slightly more than the consumer price index since 1978, but have not matched price increases in the general economy, particularly for large shippers and those in highly competitive city-pair traffic lanes. Carriers that serve small shippers and those in less competitive markets have fared better.

Capacity

One major reason for the high number of motor carrier failures over the past 8 years was the overcapacity that existed in the regulated environment. Despite the failures, however, industry analysts indicate that for several reasons, some overcapacity

persists. While the number of heavy trucks registered nationwide has declined slightly, trailers used now are longer and wider, and double trailers, which have significantly greater carrying capacity, have become commonplace on the Interstate system. In addition, industry data show all trucks are being used more productively; they are driven more miles annually and spend longer hours traveling each day.

Rate discounting has made low labor costs and high productivity essential to survival; thus carriers have found it difficult to increase driver wages and improve arduous work conditions. Nonetheless, the need to keep trucks moving has made many carriers focus on ways to make driving a more attractive occupation. Many successful companies have had to provide extra incentives to attract enough drivers, since the traditional driver pool has been shrinking.

Longer vehicles, double trailers, heavier weights, a shortage of qualified drivers, and a competitive marketplace, all have important implications for heavy truck safety. Overcapacity leads to price discounting and shrunken profit margins, creating difficult economic trade-offs for decisions about investment in safety-related equipment and safety-conscious hiring and scheduling practices. Competition, increased operating costs, and low, erratic profit margins create a need to control costs that can lead to shortchanging safety-related driver training, truck maintenance, and equipment improvements. Carriers are, in general, interested in safety, but they will measure investments in new safety equipment and technologies against tangible economic rewards. Cost and safety trade-offs are particularly problematic for owner-operators and small carriers, who have to generate revenue regularly to stay in business and may have no regular operations base or maintenance facility. **OTA concludes that Federal safety regulations will affect carriers economically with varying severity, depending on their financial reserves and stability.** Congress will want to keep this in mind as it weighs policies related to safety.

NOTE: Copies of the report "Gearing Up for Safety: Motor Carrier Safety in a Competitive Environment" can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325, GPO stock No. 052-003-01127-1.

Other OTA Assessments in Progress as of September 1988

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NOTE: For brief descriptions of these studies in progress, see OTA's booklet on "Assessment Activities"—available from OTA's Publications Office, 224-8996.

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